Topology Prediction in Mobile Ad hoc Networks

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Certificate of Authorship/Originality

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted a part of requirements for a degree except as fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

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To my parents and my wife

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List of Abbreviations

CRT	Critical Transmitting Range
FIFO	First In first Out
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
LDT	Location Data Table
LTS	Location Time Series
PFL	Predicted Future Location
RSSI	Received Signal Strength Indicators
RTS	Recent section of Time Series
SNR	Signal to Noise Ratio
TC	Topology Control
TOA	Time Of Arrival

Table of definitions

Mobile Ad Hoc Network	A set of mobile node connected by wireless links in node to node configuration without central connector. Nodes have routing capability
Bandwidth	The overall data rate between nodes in the network
Link	A channel or physical medium connecting two nodes in a network
Topology	A layout pattern of interconnection of various nodes
Prediction	To find out a future data based on current and past data
Topology prediction	To find out the future layout of the network based on some metrics
Topology discovery	To find out the current topology status of a network
Reactive approach	To find required information when needed it is also called on-demand approach
Proactive approach	Maintaining the information periodically whether it was requested or not
Unicast	Transmitting the information to a unique address
Multicast	Transmitting the information to a multiple addresses
Location service	A service that provide nodes with the geographical location of other node(s).
Polynomial regression	Find the polynomial of degree n that link an independent variable x with the dependent variable y
Cross correlation	A measure of similarity between two time series

Abstract

A mobile ad hoc network is an autonomous system of nodes that is connected by wireless links. Nodes are connected in the absence of fixed infrastructure or central management. They can freely move, join or leave the network. Arbitrary and random motion of mobile ad hoc network nodes while communicating results in frequent topology changes and multiple disconnections of links. This dynamic environment challenges the delivery of data, especially in real time applications, and imposes the need for prediction models to track these changes, and subsequent determination of the future topology of the network. The prediction of network mobility into the future will reduce the frequency of location and route updates and improve the efficiency of the network.

In this thesis, we have reviewed existing prediction methods for the mobility of nodes and proposed three new schemes to predict the future topologies of the mobile network. The proposed schemes are simple, efficient, and applicable to many existing algorithms. We evaluate the presented schemes on simulated and real data obtained from the Databases and Mobile Computing Laboratory at the University of Illinois at Chicago. The results show that the schemes successfully predict the future topology of the dynamic networks with high accuracy. They also minimise the frequency of route and location updates and any associated delays.

The implementation of the proposed schemes on the upper layers makes them applicable to various routing algorithms including topology based routing algorithms and geographical routing algorithms, giving them the advantage of platform independence.